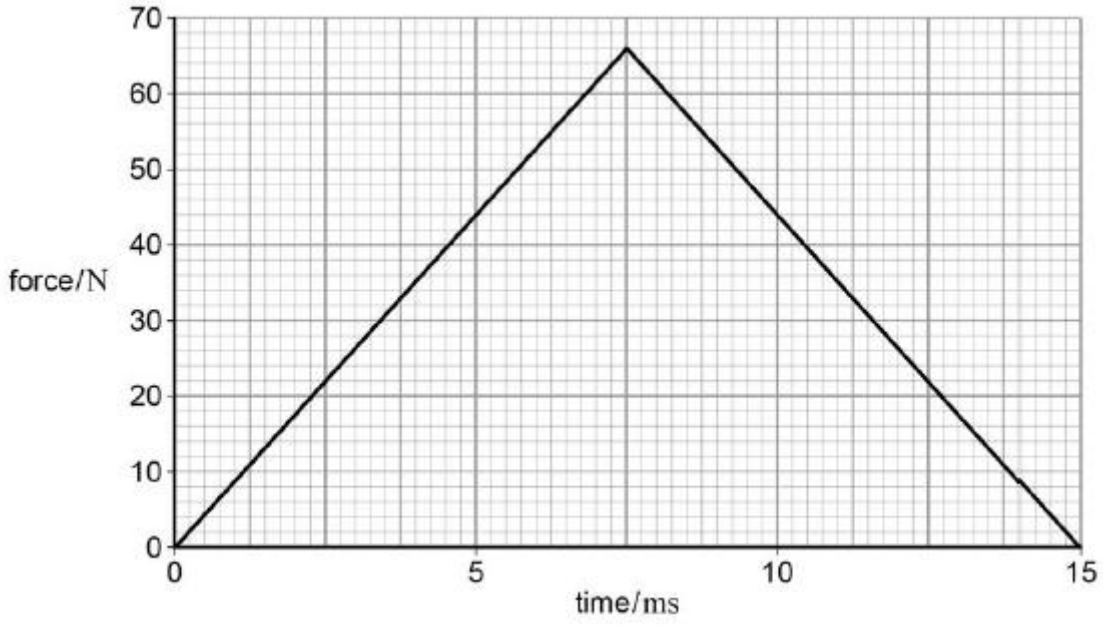
**Name of the Student**:_____
**Max. Marks : 24 Marks** **Time : 24 Minutes**

## Q1.

A golf ball is raised from the ground and dropped onto a hard plate to test the properties of the ball. A sensor measures the force exerted by the plate on the ball during its collision with the plate. The graph below shows the variation of force exerted on the golf ball with time.




(a) Show that the change in momentum of the golf ball during the collision is about 0.5 N s.

**(2)**

(b) The ball strikes the plate with a speed of 7.1 m $s^{-1}$ and has a mass of 45 g. It leaves the plate with a speed of 3.9 m $s^{-1}$.

Show that this is consistent with a change in momentum of about 0.5 N s.

**(3)**

(c) The ball continues to bounce, each time losing the same fraction of its energy when it strikes the plate. Air resistance is negligible.

Determine the percentage of the original gravitational potential energy of the ball that remains when it reaches its maximum height after bouncing three times.

gravitational potential energy remaining = _____ %

**(4)**

(d) Explain, with reference to the conservation of momentum, the effect that the motion of the golf ball has on the motion of the Earth from the instant it is released until it bounces at the plate.

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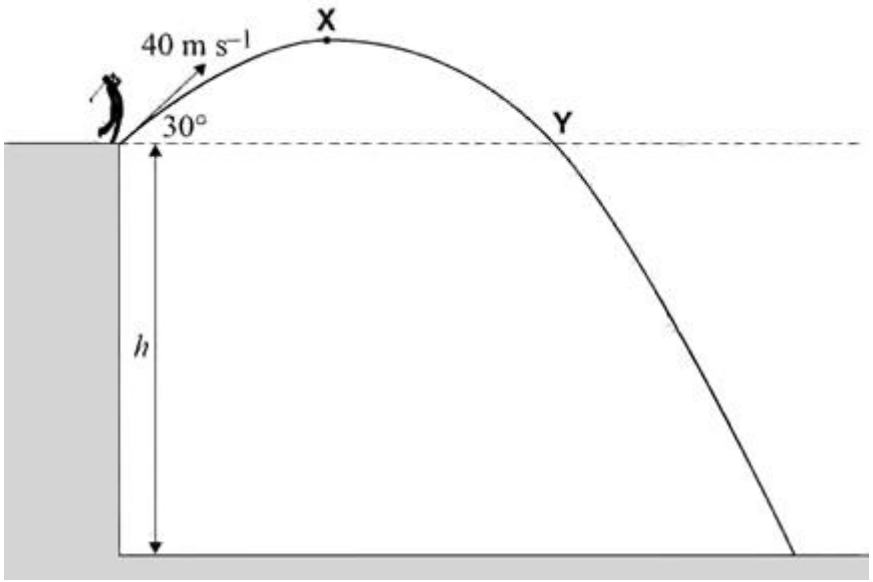
**(3)**

**(Total 12 marks)**

## Q2.

**Figure 1** shows a golfer hitting a ball from the top of a cliff. The ball follows the path shown. The ball is hit with an initial velocity of 40 m $s^{-1}$ at an angle of 30° above the horizontal, as shown. Assume that there is no air resistance.

**Figure 1**




(a) Calculate the initial vertical component of velocity of the ball.

initial vertical component of velocity = _____ m $s^{-1}$

**(1)**

(b) Draw on the diagram an arrow to show the direction of the force acting on the ball when it is at point **X**, the highest point of the flight. Label this arrow **F**.

**(1)**

(c) At point **Y** the ball is level with its initial position.

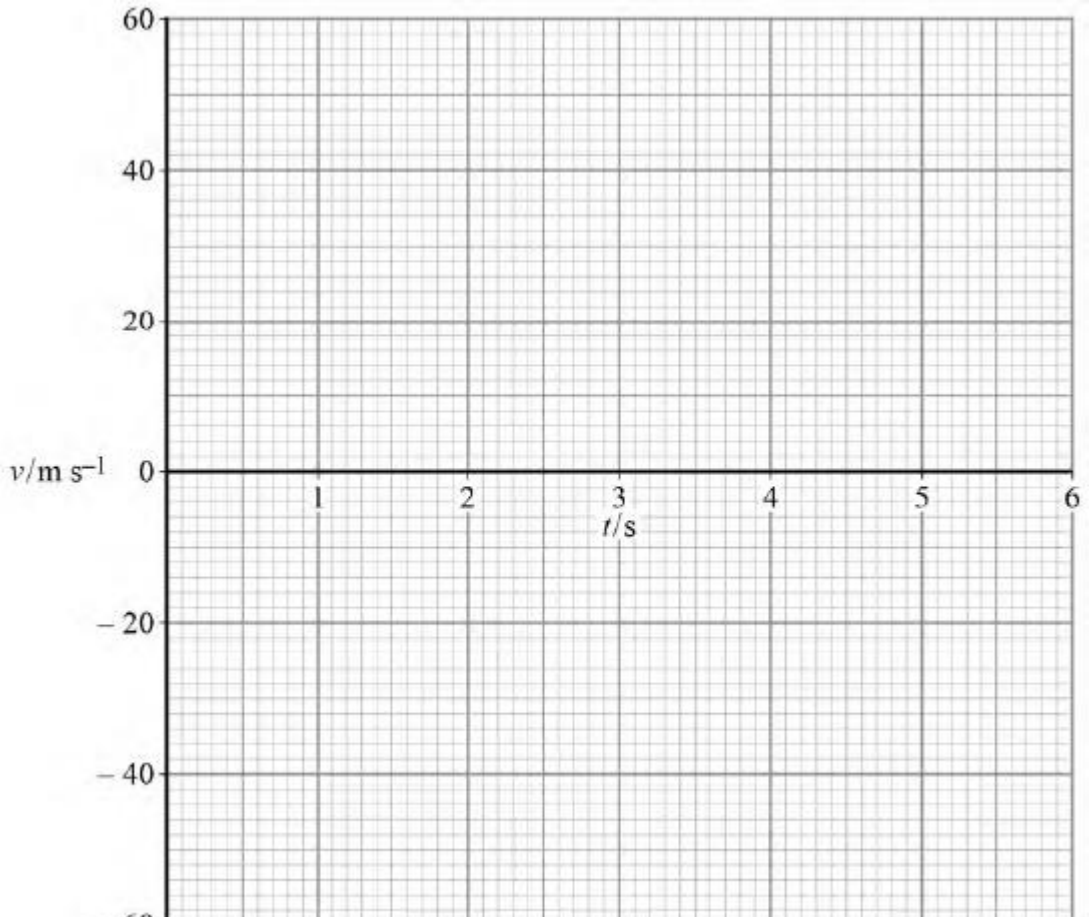
Show that the time taken to reach **Y** is about 4 s.

**(2)**

(d) The total time of flight of the ball is 6.0 s.

Show on **Figure 2** how *v*, the vertical component of the velocity, changes throughout the whole 6.0 s.

**Figure 2**




**(3)**

(e) Calculate the height $h$ of the cliff.

height _____ m

**(3)**

(f) In practice, the air resistance affects the path of the ball.

Draw on **Figure 1** the path the ball takes when air resistance is taken into account.

**(2)**

**(Total 12 marks)**